A Synopsis of

"Green synthesis of silver nanoparticles using medicinal plant extracts and assessment of its antimicrobial activity"

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Abstract

Nanotechnology research area is most active area in modern material science. Synthesis of silver nanoparticles (AgNPs) using plant green leaf extract is achieving popularity because of its environmental friendly nature and cost effectiveness and also use of aqueous extract of leaves is for stabilization or reduction purpose. Nowadays, silver nanoparticles (AgNPs) are attracting attention due to their attractive properties, such as the good electrical and thermal conductivity, photo-electrochemical activity, chemical stability, and high catalytic and antimicrobial activities. The characterization of silver nanoparticles can be done by UV-Vis spectrophotometer, whereas they can be detected by microscopic techniques like, TEM, SEM etc. The antimicrobial activity can be done with bioassay technique by employing gram positive and gram negative bacteria as test organisms.

Introduction

The term Nano originated from Greek work *Nanons* meaning dwarf. The nano is one billionth of meter. Nano particles are very very small sized particles ranging from 1 to 100 nanometer. Concept of nanotechnology was introduced by scientist Richard Feymen (Nobel Laureate in Physic) about 50 years back. Eric Dexter put forth a theory of nanotechnological world, according to him in coming years world will be completely transformed by nanoscale robot assemblers. Green synthesis is defined as the use of environmentally compatible materials such as bacteria, fungi and plants in the synthesis of nanoparticles. Nano particles have many applications in electronics, optic al communication, medical and biological systems. Silver is extensively used in nanosystems and employed in various biomedical purposes. Silver nanoparticles have excellent medical and nonmedical properties and applications when compared with other metal nanoparticles. The green approach of nanoparticles synthesis possesses reduced or no toxicity and number of plants and herbal extracts has been reported to be involved in such synthesis. Plant extracts contain number of secondary metabolite which plays a critical role during the nanoparticle synthesis by acting as reducing or capping agents. Studies have shown that silver nanoparticles are highly stable and toxic to bacteria, fungus, and viruses.

Review of Literature

The 'green' environment friendly processes are in demand and much needed due to worldwide environmental concerns (Thuesombat, *et al.*, 2014). Silver is the one of the highest commercialized nano-material (Larue *et al*., 2014) and is estimated to increase in next few years. Along with its use in biomolecular detection, catalysis, biosensors and medicine, it is also known to have strong inhibitory and bactericidal effects along with the anti-fungal, anti-inflammatory activities (El-Chaghaby and Ahmad, 2011, Veerasamy *et al*., 2011). Variety of techniques are available for the syntheses of silver nanoparticles (Bindhu and Umadevi (2015), Mahdi *et al*., 2015, Padalia *et al*., 2014, Sre *et al*., 2015); but most of these methods use hazardous chemicals with high energy requirements, which are not only difficult but give rise to hazardous contaminants (Ahmed *et al.*, 2015). Even in such situation, there is an ever-growing application of silver nanoparticles in daily life. These noble silver nanoparticles today need an alternate technology for production, which must be not only cost effective but should be environment friendly too. In this view, the green syntheses are becoming key procedure in proving their potentials. These techniques utilized for obtaining nanoparticles, employ naturally occurring compounds like sugars, biodegradable polymers (chitosan, etc.), plant extracts, which are considered attractive for nanotechnology (Ahmed *et al*., 2014, Ahmed and Ikram, 2015, Kharissova*et al*., 2013). Greener way of synthesizing nanoparticles is advantageous over other methods due to their simple, one-step, cost-

effective, environment friendly and relatively reproducible protocols (Mittal,*et al.,* 2014). Microorganisms could also be employed, however their kinetics of syntheses are highly slower as compared to plant mediated synthesis (Ahmed *et al*., 2015). The potential of higher plants as source for silver nanoparticles remain to be exploited. Various plant extracts including marigold flower (Padalia*et al*., 2014), *Solanum tricobatum*and*Ocimumtenuiflorum*(Logeswari*et al,* 2013), Erythrinaindica (Sre*et al*., 2015), Beet root (Bindhu and Umadevi, 2015),Olive (Khalil, 2013), leaf extract of *Acalyphaindica* with high antibacterial activities (Krishnaraj*et al*., 2010) are reported in literature with production of nanoparticle sizes ranging from 5 to 20 nm. Nabikhan*et al.*,,(2010) have exhibited the synthesis of nanosilver particles as an alternative to the conventional methods.Antibacterial activity of silver nanoparticles (AgNPs) is dependent on ability to anchor bacterial cell wall and to penetrate it.

Objectives of Research

- To collect various plant materials for nanoparticles production.
- To prepare plant material extracts using various techniques
- To synthesis sliver nanoparticles by using aqueous extract of plant materials
- To characterize the synthesized silver nanoparticles by spectrophotometer
- Employing plant materials extract for reductive catalysis
- To detect AgNPs by TEM and SEM
- To study antimicrobial activity of AgNPs particles against gram positive and gram negative bacteria.

Methodology to be Adopted

1. Collection of leaves from leaves from the plants and grind it to fine powder
2. Preparation of aqueous extract of plant leaves and to synthesize silver nanoparticles by using silver nitrate
3. Characterization by spectrophotometric analysis by using UV- Vis spectrophotometer
4. Detection of silver nanoparticles by transmission electron microscope
5. Conformation of NP by SEM
6. Study of antimicrobial activity of silver NP by bioassay technique using bacteria

Importance of Study and Society Application

The work of many scientists in synthesis of silver NPs opens the new world of nanotechnology gives the benefits in biological, medical aspects. Study on silver nanoparticles seems to be important and having many applications in various fields.

International Status

Synthesis of silver nanoparticles (AGNPs) is a novel nanotechnological area dealing with significant work at International and National level. Internationally green-synthesis of these particles have gained importance due to its applicability in field of biology, medical science, pharmaceuticals, cosmetics, paints, electrical and optical uses to name a few. Various researchers are exploring avenues in applying the uses of the silver nanoparticles. In Korea (Kim, *et al.*, 2011) has revealed the antibacterial activity of Silver nanoparticles against wound pathogen *Staphylococcus aureus* and *E. coli*. Hasan, *et al.(2012)* from Iran, working with silver nanoparticles studied its characteristics and antibacterial effects on bacteria. Ana Alexandra (2016) from Romania studied 'Green Synthesis' of these particles and employed it for medical applications. Nigerian researcher Jamiu, synthesized bionanoparticles using neem leaf extract and used it against enteric bacteria. Mohamad Rafi Shaikh, (2018) has also worked exhaustively on green silver bionaoparticles using *Origanum vulgare L.* plant extract and its microbicidal activities.

National Status

Various Indian researchers are working on production of silver nanoparticles employing 'Green Technology' based silver nanoparticles synthesis. Akhilesh Khushwa (2015) worked on characterization and antibacterial property of silver nanoparticles. Shobha, *et al*, (2014) exhaustively reviewed aspects of biological synthesis of copper nanoparticles and its impacts. Arpita, (2017) synthesized AgNPs from medicinal plants and characterized it using Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Atomic Force Microscopy (AFM).

Significance of Study

Silver nanoparticles are significantly applicable in various technologies and integrated into a wide range of consumer products which benefits due to their optical, conductive, and antibacterial properties.

- **Diagnostic Uses:** Silver nanoparticles are used in biosensors and several assays in which they are used as biological tags for quantitative detection.
- **Antibacterial Uses:** Silver nanoparticles can also be included in apparel, footwears, paints, wound dressings, appliances, cosmetics, and plastics for their antibacterial properties.
- **Conductive Uses:** Silver nanoparticles are employed in conductive inks and integrated into composites to enhance thermal and electrical conductivity.
- **Optical Uses:** Silver nanoparticles are used to proficiently harvest light and for improved optical spectroscopies which include metal-enhanced fluorescence (MEF) and surface-enhanced Raman scattering (SERS)

Proposed work Plan

1. Preparation of plant leaf extract
2. Preparation of Silver NPs by using $AgNO_3$
3. Stabilization study with UV-VIS spectrophotometer
4. Detection of NPs by TEM and SEM
5. Antimicrobial study by using bacteria

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